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Science for Environment Policy

Polystyrene microplastics negatively affect oyster feeding, reproduction and offspring

Oysters exposed to polystyrene microplastics produced fewer offspring, which were also smaller and slower growing than offspring from unexposed oysters, according to recent research. The researchers say their study adds to growing evidence of the harm caused by microplastic pollution and can help stakeholders to take action on plastic debris entering the oceans to limit its long-term impact on marine life.

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Microplastics, tiny fragments of plastic less than 5 mm in diameter, are found throughout the world's oceans. Used extensively, for example in personal care products, they enter the oceans via household or industrial wastewater. They are also formed when larger pieces of plastic are broken down by wave action or are degraded by ultraviolet light.

There is increasing concern about the effects of microplastics on marine organisms. Polystyrene is one of the most commonly used polymers worldwide, and is often found in microplastics sampled at sea. Filter-feeders, such as oysters and mussels, which obtain their food by filtering phytoplankton from copious amounts of water, are particularly susceptible to consuming large quantities of microplastics along with their food. Oysters and other filter-feeders perform a vital role in coastal and estuarine environments by removing nutrients and algae from water and improving overall water quality.

This study investigated the effect of microplastic pollution on *Crassostrea gigas*, the Pacific oyster. Found in the temperate regions of the Pacific Ocean, *C. gigas* is one of the most commonly produced species of oyster in the world. It is widely cultivated along coastal areas of Australia, New Zealand and North America, as well as many areas of Europe, including France, the Netherlands, Portugal, Spain and the UK.

Researchers placed oysters in 50-litre tanks of seawater. Oysters in half the tanks were fed a diet of algae and polystyrene microspheres (micro-PS) (which were 2 micrometre — µm — and 6 µm in diameter and present at a concentration of 0.023 milligrams per litre (mg/L), which is below the concentration of polystyrene estimated to occur where wild oysters live). The control oysters in the other half of the tanks were fed the same algae diet, without the micro-PS.

At regular intervals over two months, the researchers estimated the amount of algae and micro-PS eaten by the oysters and measured the organic content of their faeces to determine how efficiently the oysters absorbed their food. The researchers also analysed samples of flesh, haemolymph (fluid in their circulatory system) and gonads (sex organs).

Altogether, the researchers found that the polystyrene altered the feeding, energy use and reproduction of exposed oysters.

Exposed oysters consumed significantly more algae and absorbed the food more efficiently than unexposed oysters. The researchers say this may be because the polystyrene microspheres disrupt the oysters' digestion — which they compensate for by increasing their food intake. The presence of the microspheres may also enhance mechanical digestion — as has been demonstrated in response to moderate silt ingestion. Genetic tests on the digestive glands also indicated that the polystyrene may be disrupting digestive processes.

Continued on next page.

Source: Sussarellu, R., Suquet, M., Thomas, Y., Lambert, C., Fabioux, C., Pernet, M.E.J., Le Goïc, N., Quillien, V., Mingant, C., Epelboin, Y., Corporeau, C., Guyomarch, J., Robbens, J., Paul-Ponta, I., Soudant, P. & Huvet., A. (2016) Oyster reproduction is affected by exposure to polystyrene microplastics. *Proceedings of the National Academy of Sciences*. 113 (9): 2430–2435. DOI:10.1073/pnas.1519019113. This study is free to view at: http://www.pnas.org/content/113/9/2430.abstract

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However, the polystyrene compromised the reproductive health of the oysters. Exposed females produced 5% smaller and 38% fewer oocytes (developing eggs) than unexposed females. The swimming speed of sperm (an indication of a male's fertility) from exposed males was 23% slower than that of sperm from unexposed males. Moreover, 41% fewer larvae were produced from the eggs and sperm of exposed individuals and the larvae grew more slowly and were 18% smaller, compared with larvae produced from unexposed oysters. These results suggest that polystyrene pollution may have long-term effects on future populations of wild and cultivated Pacific oysters, which may affect coastal and estuarine ecosystems and aquaculture.

The researchers also modelled how oysters used the food they consumed. They found that the balance of energy shifted: energy that would normally be allocated for reproduction shifted towards maintenance and growth in exposed oysters. There were also some indications that the polystyrene microspheres may be acting as endocrine disruptors, and the researchers quote other studies that suggest microplastics could disrupt endocrine function, either alone or in combination with other persistent pollutants.

This study serves as an early warning of the potential long-term harm that filter-feeders, such as oysters in coastal areas, may face from microplastic pollution. The researchers say the strong negative effects found by their study should encourage decision makers to limit the impact of microplastics in decades to come.

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